Comparative Results of Six Different Benthic Macroinvertebrate Sampling Methods for Riverine Ecosystems

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Final Objective of Project:
Provide states, regions, and tribes with guidance on the selection of methods for sampling the benthic macroinvertebrate fauna of large rivers.

This Presentation:
Early analysis of data collected from 60 sites on four rivers in the Ohio River basin.

Study Area:

Field Methods:
After reviewing the benthic macroinvertebrate sampling protocols for rivers of several agencies, we selected six sampling methods to emulate in this study.

KN Kick-Net (Semi-Quantitative: One Bank): Two 20-second kicks using a modified kick net (50-cm x 30-cm opening with 595-µm mesh) were performed at 11 evenly-spaced transects along one bank over a 2000-m distance. Field processing of collected material was conducted with a 595-µm sieve.

TH Targeted Habitat: 1000 m (Semi-Quantitative: Both Banks): Sampling targeted 5 or 6 areas of richest targeted habitat (rocks, snags and macrophytes) within a 1000-m reach. At each habitat, a 50-cm x 50-cm area was sampled. Field processing of collected material was conducted with a 425-µm sieve.

DP 500 Dip-Net/Pick 500 m (Qualitative: Both Banks): Sampled all available habitat types over a 500-m distance using a D-frame dip net (595-µm). Field processing of collected material was conducted with a 595-µm sieve.

DP1000 Dip-Net/Pick 1000 m (Qualitative: Both Banks): Sampled all available habitat types on either bank over a 1000-m distance using a D-frame dip net (210-µm). Field processing of collected material was conducted with a 210-µm sieve.

DN Drift-Net (Quantitative): Two drift nets with 30.48-cm x 45.72-cm openings (595-µm) were deployed during daylight hours at each site for a four-hour period. Field processing of collected material was conducted with a 595-µm sieve.

HD Hester-Dendy (Quantitative): Five Hester-Dendy multi-plate samplers were deployed for six weeks at each sampling site. Total surface area of each sampler was approximately 1.0 ft² or 0.092 m². Upon retrieval, samplers were disassembled in the field, and collected organisms were removed and composited into a single sample. Field processing of collected material was conducted with a 595-µm sieve.

Laboratory Methods:
A single laboratory method was used to process all samples. Subsamples of 300 (±10%) organisms were identified to the lowest possible taxonomic level.

Statistical Analysis:
Sampling methods were compared within each site using a non-parametric repeated measures ANOVA (Friedman Test) and associated multi-comparison procedures.

Future Direction of Analysis:
- Incorporate insight and ideas of reviewers into the final analysis of this data.
- Determine consistency of these results with data currently being processed from three additional rivers.
- Determine the influence of sampling methods on other macroinvertebrate metrics.
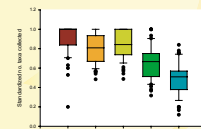

Effect on Numbers of Individuals Collected and Taxa Richness

**Did all methods collect sufficient numbers of organisms?**
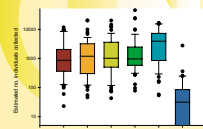
- No. The DN method consistently collected insufficient numbers of organisms for our purposes. As a result, they were excluded from further analyses.

Did the number of taxa vary across methods?

- Yes. S' = 108.2, p < 0.0001.
- The KN, DP500, DP1000 methods collected the largest number of taxa, followed by the RTH method and then the HD method.

Was the percentage of total richness (across all methods) collected by each method affected by taxonomic level of identification?
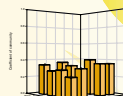
- Even at the genus and family levels of identification, no single method collected a large proportion of the total number of taxa consistently.
- The KN, DP500, and DP1000 methods consistently collected a larger percentage of the total richness than other methods, followed by the RTH method and then the HD method.

Conclusions to this point:

Effect on Numbers of Individuals Collected and Taxa Richness

- Number of individuals collected by the DN method was too low as this method was employed in this study. The literature suggests that this method would be much more effective at night.
- The KN, DP500, and DP1000 methods collected more taxa than the HD and RTH methods.
- Although total richness was similar among the KN, DP500, and DP1000 methods, they were not collecting the same set of taxa. The HD method was least similar in taxa to the other methods.


Effect on Taxa Composition

**Were the various sampling methods collecting the same taxa?**
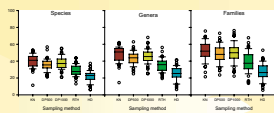
- All of the Coefficient of Community values were relatively low, indicating low overlap of species among the methods.
- The taxa collected by the HD method were most similar to the RTH method. The other three methods collected the most similar taxa.

Did the number of Diptera taxa vary across methods and/or rivers?
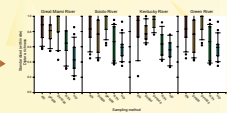
- Yes. S' = 81.29, p < 0.0001.
- KN method always collected significantly more Diptera taxa than the HD method.
- The DP1000 collected more Diptera taxa than the HD method in all except the Green River.

**Did the percentage of mayflies vary across methods and/or rivers?**
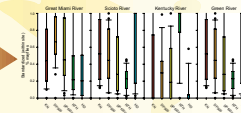
- In the Great Miami River, the DP500 method collected a higher percentage of mayflies (Ephemeroptera) than the RTH and HD methods.
- In the other three rivers, there were no differences among methods for this metric.

Effect on Taxa Composition

- No single method captured more than about 50% of the total richness achieved by all methods combined at a site.
- This conclusion was not affected greatly by the taxonomic resolution used.
- The KN and DP1000 tended to collect more Diptera taxa than the HD method.
- There was no strong effect of method on percent mayfly individuals, although mayflies were not common in general.


Effect of Depth

How does reach depth influence metric values?
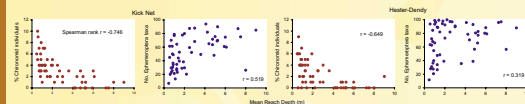
- At greater mean depths, number of mayfly (Ephemeroptera) taxa was greatly reduced, regardless of sampling method.
- Percent chironomid individuals shows a general increasing trend with increasing mean depth using the kick net, but this trend is less evident with the Hester-Dendy sampler.

How is reach depth related to species composition, based on a Detrended Correspondence Analysis (DCA)?
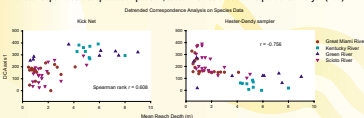
- For both the EMAP kick net and the Hester-Dendy sampling methods, there is a relationship between species composition (DCA axis 1) and mean reach depth.
- The two deeper rivers (Kentucky and Green Rivers) appear to have a somewhat different species composition from the Great Miami and Scioto Rivers.
- Mean reach depth may be confounded with other physical habitat features or condition.

Effect on Diptera

- The number of mayfly taxa decreased with increasing mean reach depth, while the percent chironomids increased with increasing mean reach depth.
- The species composition was also related to mean reach depth.
- Further analysis of physical habitat data is needed to determine whether depth is the actual source of variation or simply confounded with some other measure.